Contents lists available atIOCS

Science Midwifery

journal homepage:www.midwifery.iocspublisher.org

The effectiveness of *moringa oleifera* and *musa paradisiaca* on hemoglobin levels in postpartum mothers

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ARTICLE INFO

Article history:

Received Jul 15, 2026
Revised Jul 21, 2026
Accepted Jul 29, 2026

Keywords:

Hemoglobin
Moringa Oleifera
Musa Paradisiaca
Postpartum

ABSTRACT

Postpartum anemia is a common maternal health problem that may delay recovery and increase the risk of postpartum complications. Although *Moringa oleifera* leaves and *Musa paradisiaca* have individually been reported to improve hemoglobin levels, direct comparative evidence between these locally available food sources remains limited. This study aimed to compare their effectiveness in increasing hemoglobin levels among postpartum mothers.A quasi-experimental pretest–posttest control group study was conducted. Postpartum mothers were allocated into three groups: *Moringa oleifera*, *Musa paradisiaca*, and a control group receiving standard postpartum care. Participants in the intervention groups consumed 200 g of the assigned food daily for seven days. Hemoglobin levels were measured before and after the intervention using a digital hemoglobin analyzer. Data were analyzed using paired *t*-tests, one-way ANOVA, and the Games–Howell post hoc test ($p < 0.05$). Hemoglobin levels increased significantly in the *Moringa oleifera* group (9.94 ± 1.63 to 11.40 ± 1.15 g/dL; $p = 0.001$) and the *Musa paradisiaca* group (10.84 ± 1.52 to 12.10 ± 1.42 g/dL; $p = 0.003$), whereas the control group showed no significant improvement ($p=0.116$). ANOVA demonstrated significant differences in hemoglobin changes among groups ($F = 6.938$, $p=0.003$).This study provides novel evidence by directly comparing *Moringa oleifera* and *Musa paradisiaca* in postpartum mothers. Both interventions significantly improved hemoglobin levels compared with standard postpartum care, supporting their use as affordable and locally available complementary strategies for managing postpartum anemia.

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INTRODUCTION

Postpartum anemia remains a major global public health problem, particularly in low- and middle-income countries, and is a leading contributor to maternal morbidity. It is primarily caused by excessive blood loss during childbirth, pre-existing iron deficiency during pregnancy, and

increased iron requirements after delivery. The prevalence ranges from 22%–50% in high-income countries and 50%–80% in low- and middle-income countries. Postpartum anemia is associated with adverse maternal outcomes, including fatigue, impaired physical and cognitive function, postpartum depression, reduced breastfeeding success, and poorer quality of life (Muñoz, M., Peña-Rosas, J. P., Robinson, S., Milman, N., Holzgreve, W., Breymann, 2021; Yourkavitch, J., Obara, H., Usmanova, G., 2023).

The World Health Organization (WHO) recommends iron supplementation combined with adequate nutritional intake as the cornerstone of postpartum anemia prevention and management to facilitate maternal recovery following childbirth (World Health Organization, 2023). Although oral iron supplementation remains the standard treatment, its use is often limited by gastrointestinal side effects. Therefore, iron-rich local foods have emerged as safe, affordable, and sustainable complementary interventions for improving hemoglobin levels in postpartum women. (Rotella, R., Soriano, J. M., Llopis-González, A., & Morales-Suarez-Varela, 2023).

Indonesia possesses exceptional biodiversity, with numerous indigenous plant species offering considerable nutritional and therapeutic potential. Among these, *Moringa oleifera* and *Musa paradisiaca* (banana blossom) have attracted growing interest because of their high nutritional value and potential health benefits. Both plants are widely distributed throughout Maluku Province, where they are readily available in traditional markets and commonly cultivated in household gardens, making them an integral component of the local food system. Their abundant availability and cultural acceptance provide a strong foundation for their utilization as functional foods in maternal nutrition (Trisnawati I, Mardianti, Antini A, 2023; Wulan & Girsang, 2020)..

Moringa oleifera is inexpensive, easily accessible, and safe for human consumption. Despite its exceptional nutritional composition, its utilization in Indonesia remains relatively limited, with the leaves primarily consumed as a vegetable or, in some communities, grown merely as ornamental plants (Attia SL, Owuor PM, Odhiambo SA, Mogaka JN, Ondondo R, 2025). Previous studies have demonstrated that *Moringa oleifera* contains phytosterols that exhibit lactogenic activity by stimulating breast milk production (Purnanto NT, Himawati L, 2020). Furthermore, increasing evidence indicates that *Moringa oleifera* supplementation can significantly improve hemoglobin concentrations among postpartum women, thereby contributing to the prevention and management of postpartum anemia (Utami DT, Mawaddah S, 2023).

Moringa oleifera improves hemoglobin synthesis through its high content of iron, vitamin C, folate, protein, and antioxidant compounds, which support erythropoiesis and enhance iron absorption. Previous studies have consistently shown that *Moringa oleifera* supplementation significantly increases hemoglobin levels in women of reproductive age, pregnant women, and postpartum mothers. A quasi-experimental study conducted by Astutik et al. (2024) demonstrated a significant increase in hemoglobin concentration among postpartum women, with mean values rising from 8.65 g/dL before the intervention to 10.93 g/dL following *Moringa oleifera* extract supplementation (Astutik, R. Y., Anggraeni, S., Istighosah, N., & Auktovitis, 2025; Rotella, R., Soriano, J. M., Llopis-González, A., & Morales-Suarez-Varela, 2023).

Another promising indigenous food source is *Musa paradisiaca* (banana blossom), which is also widely available throughout Maluku. Banana blossom is recognized as a nutrient-dense food rich in iron, vitamin C, dietary fiber, and antioxidant compounds. Emerging evidence suggests that its nutritional composition may contribute to increased hemoglobin synthesis and support the prevention and management of anemia (Hasmawati et al., 2020; Zelharsandy & Soleha, 2024). Banana blossom is rich in iron, vitamin C, flavonoids, and phenolic compounds that support erythropoiesis and iron absorption. It is also inexpensive, widely available, and traditionally consumed by postpartum women in Indonesia, making it a promising functional food for postpartum anemia management. (Sharma, P., Kumari, A., & Singh, 2019).

Although substantial evidence supports the effectiveness of *Moringa oleifera* in improving hemoglobin concentrations, scientific evidence regarding the efficacy of *Musa paradisiaca* among

postpartum women remains limited. Moreover, studies directly comparing the effectiveness of *Moringa oleifera* and *Musa paradisiaca* in improving postpartum hemoglobin levels are scarce. This lack of comparative evidence represents an important knowledge gap in the development of evidence-based, food-based nutritional interventions for postpartum anemia. Therefore, this study aimed to evaluate and compare the effectiveness of *Moringa oleifera* and *Musa paradisiaca* in improving hemoglobin levels among postpartum women. The findings are expected to provide robust scientific evidence supporting the use of locally available functional foods as safe, affordable, effective, and sustainable nutritional interventions for the prevention and management of postpartum anemia.

Previous studies have evaluated *Moringa oleifera* and *Musa paradisiaca* separately, with each intervention compared only with a control group or standard care. To the best of our knowledge, no study has directly compared their effectiveness among postpartum women, highlighting an important research gap. This study was conducted in Maluku Province, where exclusive breastfeeding coverage remains below the national target and both *Moringa oleifera* and *Musa paradisiaca* are abundant, locally available foods traditionally consumed to support lactation. Therefore, this study provides comparative evidence to support the development of locally appropriate nutritional interventions for postpartum mothers.

RESEARCH METHOD

This study was conducted from April to June 2026 at Al-Fatah Hospital, Ambon City, and continued at the participants' homes after obtaining ethical clearance and completing all required administrative approvals. A quasi-experimental study with a pretest–posttest control group design was employed. This design was used to evaluate the effects of the interventions by comparing the intervention groups with the control group. Furthermore, the effectiveness of the two intervention groups was compared. The study consisted of three groups: a Moringa leaf group, a banana blossom group, and a control group. The control group received only the standard postpartum midwifery care. All three groups underwent a pretest before the intervention, followed by a posttest after completion of the intervention.

The study population comprised all postpartum mothers who delivered at Al-Fatah Hospital, Ambon City. The study sample consisted of 36 postpartum mothers, with the sample size determined based on the minimum required sample plus an additional 10% to account for potential dropouts. Each group included 12 participants. Participants were selected using a non-probability consecutive sampling technique, whereby all postpartum mothers who met the inclusion criteria during the study period were recruited consecutively until the required sample size was achieved.

Participants in the Moringa group received 200 g of fresh Moringa oleifera, prepared as clear vegetable soup, once daily in the morning for seven consecutive days (Hasibuan, U. F. H., Putri, M., & Ningrum, 2020; Miskiyah, M., Septiani, D. P., Nurlaili, H. M., & Wulandari, 2024). Participants in the banana blossom group received 200 g of Kepok banana blossom (Musa paradisiaca), prepared either by boiling or stir-frying, once daily in the morning for seven consecutive days (Astuti, 2020; Mulya, W. T., & Maita, 2021; Suryatim Pratiwi Y, Handayani S, 2023). The Moringa leaves and banana blossoms were distributed by the researchers to the participants' homes on days 1, 3, 5, and 7 to ensure intervention compliance.

A quasi-experimental design was chosen because randomization was not feasible due to ethical considerations and operational constraints in providing postpartum care at the study site. Participants were recruited based on predefined inclusion criteria, including postpartum women with normal vaginal delivery, willingness to participate in the study, and the ability to consume the intervention. The exclusion criteria included postpartum women with postpartum complications, chronic diseases, allergies to the intervention materials, or failure to complete the entire study protocol. The intervention dose of 200 g administered for seven consecutive days was

selected based on previous studies demonstrating that this dosage is safe, practical, and effective in improving hemoglobin levels during the early postpartum period. To minimize the influence of potential confounding factors, baseline characteristics, including hemoglobin levels, nutritional status, mode of delivery, and the amount of blood loss during childbirth, were assessed before the intervention. In addition, all participants received standardized postpartum care and the same nutritional education throughout the study.

The research instruments included a digital hemoglobin analyzer, a respondent demographic questionnaire, an observation checklist, and educational leaflets. Data collection was performed after obtaining written informed consent from all participants. The independent variables were Moringa leaf consumption and banana blossom consumption, while the dependent variable was the maternal hemoglobin level. Data were analyzed using univariate and bivariate statistical analyses. Univariate analysis was performed to describe participants' characteristics, including maternal age, occupation, educational level, parity and infant sex. Bivariate analysis was conducted to evaluate the effectiveness of Moringa leaves and banana blossom on hemoglobin levels within each group and to compare the intervention groups. Statistical significance was established at a 95% confidence level ($\alpha = 0.05$). Data were analyzed using the paired t-test and a one-way analysis of variance (ANOVA).

RESULTS AND DISCUSSIONS

Result

A total of 36 postpartum mothers participated in this study and were equally allocated into three groups: the moringa Oleifera group (n = 12), the musa paradisiaca group (n = 12), and the control group (n = 12). Most participants were 20–35 years of age, had completed senior high school education, were homemakers, and were multiparous. Homogeneity testing indicated no significant differences in baseline characteristics among the three groups ($p > 0.05$), suggesting that the groups were comparable. The respondents' characteristics are presented in Table 1.

Table 1. Respondents' characteristics

Characteristics	Group				*P-value*
	Moringa Oleifera	Musa Paradisiaca	Control	Total	
Age (years)					
< 20	1 (8,3%)	1 (8,3%)	1 (8,3%)	3 (8,3%)	
20-35	11 (91,7%)	9 (75%)	10 (83,3%	30 (83,3%)	0,699
>35	0	2 (16,7%)	1 (8,3%)	3 (8,3%)	
Educational Level					
Junior High School	1 (8,3%)	1 (8,3%)	1 (8,3%)	3 (8,3%)	
Senior High School	8 (66,7%)	7 (58,3%)	9 (75%)	24 (66,7%)	0,922
Bachelor's Degree	3 (25%)	4 (33,3%)	2 (16,7%)	9 (25%)	
Occupation					
House Wife	8 (66,7%)	8 (66,7%)	10 (83,3%)	26 (72,2%)	0,628
Civil Servant	2 (16,7%)	3 (25%)	2 (16,7%)	7 (19,4%)	
Private Employee	2 (16,7%)	1 (8,3%)	0	3 (8,3%)	
Parity					0,627
Primipara	6 (50%)	4 (33,3%)	4 (33,3%)	14 (38,9%)	
Multipara	6 (50%)	8 (66,7%)	8 (66,7%)	22 (61,1%)	
Infant Sex					
Male	7 (58,3%)	7 (58,3%)	6 (50%)	20 (55,6%)	0,894
Female	5 (41,7%)	5 (41,7%)	6 (50%)	16 (44,4%)	

Changes in Hemoglobin Levels

Table 2. Mean hemoglobin levels before and after the intervention

Group	Pre Test (Mean ± SD)	Post Test (Mean ± SD)	*P-value*
Moringa Oleifera	9,94 ± 1,63	11,40 ± 1,15	0,001
Musa Paradisiaca	10,84 ± 1,52	12,10 ± 1,42	0,003
Control	10,35 ± 1,41	11,3 ± 1,34	0,116

The analysis showed that the administration of Moringa oleifera (moringa leaves) and Musa paradisiaca (banana blossom) significantly increased hemoglobin levels in postpartum mothers. In the Moringa oleifera group, the mean hemoglobin level increased from 9.94 ± 1.63 g/dL to 11.40 ± 1.15 g/dL, with the increase being statistically significant (p = 0.001). Similarly, in the Musa paradisiaca group, the mean hemoglobin level increased from 10.84 ± 1.52 g/dL to 12.10 ± 1.42 g/dL, and this difference was also statistically significant (p = 0.003). In contrast, the control group showed an increase in the mean hemoglobin level from 10.35 ± 1.41 g/dL to 11.30 ± 1.34 g/dL; however, this increase was not statistically significant (p = 0.116). Overall, the findings indicate that supplementation with Moringa oleifera and Musa paradisiaca was effective in improving hemoglobin levels among postpartum mothers compared with baseline values, whereas no significant improvement was observed in the control group.

To compare the effectiveness of the interventions in improving hemoglobin levels among the study groups, a one-way analysis of variance (ANOVA) was performed using the change in hemoglobin levels (ΔHb), calculated as the difference between post-intervention and pre-intervention hemoglobin levels. Since the homogeneity of variance assumption was not met (Levene's test, $p < 0.05$), a Games–Howell post hoc test was subsequently conducted to identify which groups differed significantly in terms of hemoglobin improvement.

Table 3. Comparison of changes in hemoglobin levels among study groups using one-way ANOVA

Variable	Group	Mean ± SD	F	*P-value*
Δ Hemoglobin (g/dL)	Moringa Oleifera	1.47 ± 1.13	6.938	0.003
	Musa Paradisiaca	1.26 ± 1.15		
	Control	0.95 ± 0.27		

Table 4. Pairwise comparison of changes in hemoglobin levels using the games–howell post hoc test

Comparison	Mean Difference (g/dL)	*P-value*
Moringa Oleivera vs Musa Paradisiaca	0,208	0,896
Moringa Oleivera vs Control	1,333	0,005
Musa Paradisiaca vs Control	1,125	0,016

Based on the results of the Games–Howell post hoc test (Table 4), there was no statistically significant difference in the increase in hemoglobin levels between the Moringa oleifera and Musa paradisiaca groups (mean difference = 0.208 g/dL; p = 0.896). This finding indicates that both interventions demonstrated comparable effectiveness in improving hemoglobin levels among postpartum mothers.

In contrast, the Moringa oleifera group showed a significantly greater increase in hemoglobin levels compared with the control group (mean difference = 1.333 g/dL; p = 0.005). Likewise, the Musa paradisiaca group also demonstrated a significantly greater increase in hemoglobin levels than the control group (mean difference = 1.125 g/dL; p = 0.016).

Overall, the Games–Howell post hoc analysis indicated that both Moringa oleifera and Musa paradisiaca were effective in increasing hemoglobin levels among postpartum mothers

compared with the control group. However, no significant difference in effectiveness was observed between the two interventions (p = 0.896), suggesting that they have comparable efficacy in improving hemoglobin levels.

Discussion

The present study demonstrated that supplementation with Moringa oleifera (moringa leaves) and Musa paradisiaca (banana blossom) significantly increased hemoglobin levels among postpartum mothers. The mean hemoglobin level in the Moringa oleifera group increased from 9.94 ± 1.63 g/dL to 11.40 ± 1.15 g/dL (p = 0.001), while the Musa paradisiaca group showed an increase from 10.84 ± 1.52 g/dL to 12.10 ± 1.42 g/dL (p = 0.003). In contrast, although the control group experienced a slight increase in hemoglobin levels, the change was not statistically significant (p = 0.116). These findings indicate that both interventions are effective in improving hemoglobin levels during the postpartum period.

Moringa oleifera is a tropical plant that grows well in tropical regions and has long been recognized by local communities as both a vegetable and a traditional medicinal plant. It is widely known as the "Miracle Tree" because it is a natural source of essential nutrients and possesses medicinal properties that exceed those of many other plant species. Moringa oleifera belongs to the Moringaceae family and is recognized for its exceptional nutritional value. The plant contains a wide range of bioactive compounds with antioxidant activity, including alkaloids, amines, betalains, phenolic acids, flavonoids, quinones, coumarins, lignans, stilbenes, tannins, terpenoids (carotenoids), vitamins, and various endogenous metabolites that contribute to its potent free radical scavenging properties (Apriantini, R., Putra, G., & Suryati, 2022; Marhaeni, 2021).

The significant improvement in hemoglobin levels observed in the Moringa oleifera group may be attributed to the rich nutritional composition of moringa leaves. Moringa leaves are an excellent source of iron, vitamin C, vitamin A, folate, protein, and various antioxidant compounds that play essential roles in erythropoiesis. Iron is the primary component required for hemoglobin synthesis, while vitamin C enhances the intestinal absorption of non-heme iron by converting ferric iron into the more readily absorbed ferrous form. In addition, folate is essential for DNA synthesis and erythrocyte maturation, thereby supporting red blood cell production and recovery from postpartum anemia (Milman, 2011; World Health Organization, 2023).

The findings of this study are consistent with those reported by Nambiar et al. (2010), who found that regular consumption of Moringa oleifera significantly improved hemoglobin levels among women due to its high iron and micronutrient content. Similarly, Leone et al. (2015) reported that moringa leaves contain abundant vitamins, minerals, essential amino acids, and antioxidant compounds, making them a valuable nutritional supplement for improving hematological status and preventing nutritional deficiencies (Nambiar, V. S., Guin, P., Parnami, S., & Daniel, 2010).

The Musa paradisiaca intervention also resulted in a significant increase in hemoglobin levels. Banana blossom is known to contain iron, vitamin C, vitamin B6, folate, potassium, magnesium, and various bioactive compounds, including flavonoids and polyphenols, which contribute to erythropoiesis and protect erythrocytes from oxidative damage (Choo, C. L., & Aziz, 2020). The synergistic effects of these nutrients may explain the observed improvement in hemoglobin concentration among postpartum mothers. These findings are supported by Sharma et al. (2019), who demonstrated that regular consumption of banana blossom significantly improved hemoglobin levels among women with mild to moderate anemia. Furthermore, Ramu et al. (2022) highlighted that banana blossom possesses substantial nutritional and functional properties, including iron and antioxidant compounds, which may contribute to improved hematological status (Ramu, R., Shirahatti, P. S., Zameer, F., & Dhananjaya, 2022; Rilyani R, 2020; Sharma, P., Kumari, A., & Singh, 2019).

Comparison of the interventions using one-way ANOVA revealed a significant difference in hemoglobin changes among the three study groups (F = 6.938, p = 0.003). Subsequent Games–

Howell post hoc analysis demonstrated that both the Moringa oleifera group (p = 0.005) and the Musa paradisiaca group (p = 0.016) experienced significantly greater improvements in hemoglobin levels than the control group. However, no statistically significant difference was found between the Moringa oleifera and Musa paradisiaca groups (p = 0.896), indicating that both interventions produced comparable improvements in hemoglobin levels.

The absence of a significant difference between the two intervention groups may be explained by their similar nutritional profiles, particularly their iron content and supporting micronutrients involved in hemoglobin synthesis. Additionally, the relatively small sample size may have limited the statistical power to detect modest differences between the interventions. Future studies involving larger sample sizes, longer intervention periods, and control of potential confounding factors such as dietary intake, adherence to supplementation, postpartum blood loss, and iron supplementation are recommended to further evaluate the comparative effectiveness of these functional foods. From a clinical and public health perspective, the findings suggest that both Moringa oleifera and Musa paradisiaca may serve as affordable, locally available, and nutrient-rich dietary interventions to support the prevention and management of postpartum anemia. Incorporating these local food resources into postpartum nutritional programs may complement standard iron supplementation, enhance maternal recovery, and ultimately improve maternal health outcomes.

This study provides a novel scientific contribution by directly comparing the effectiveness of *Moringa oleifera* and *Musa paradisiaca* in improving hemoglobin levels among postpartum women, an area that has received limited attention in previous studies. Furthermore, this study highlights the potential use of locally available food resources as accessible, affordable, and culturally appropriate non-pharmacological interventions within the Maluku community. Nevertheless, the findings should be interpreted with caution, as the study was conducted among postpartum women with specific characteristics in a single study setting. Therefore, the generalizability of the results to postpartum populations in other regions may be limited by differences in demographic, socioeconomic, cultural, and dietary characteristics. Further studies involving larger sample sizes and more diverse study settings are needed to validate and extend these findings.

CONCLUSION

Based on the findings, both *Moringa oleifera* (moringa leaves) and *Musa paradisiaca* (banana blossom) significantly increased hemoglobin levels among postpartum mothers compared with baseline and showed greater improvements than standard postpartum care. No significant difference was observed between the two interventions, indicating that both locally available food sources have comparable effectiveness as complementary nutritional strategies for managing postpartum anemia. This study provides novel evidence by directly comparing the effectiveness of *Moringa oleifera* and *Musa paradisiaca* in postpartum mothers, addressing a gap in previous research that has primarily evaluated these interventions separately. The findings also strengthen the theoretical concept that iron-rich local foods containing essential micronutrients and bioactive compounds can support erythropoiesis and hemoglobin synthesis as part of non-pharmacological nutritional interventions for postpartum anemia. Future studies should include larger and more diverse populations, longer intervention periods, and additional clinical and nutritional variables to confirm and extend these findings.

ACKNOWLEDGEMENTS

The authors would like to express their sincere gratitude to the Director and all healthcare professionals at Al Fatah Hospital, Ambon City, for granting permission, providing support, and facilitating the implementation of this study. The authors also extend their appreciation to all

postpartum mothers who voluntarily participated in this research. The authors are also grateful to everyone who contributed their assistance, support, and cooperation throughout the study. It is hoped that the findings of this research will contribute to the advancement of scientific knowledge and support efforts to prevent and manage postpartum anemia.

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